

Measurement/Technical Report

Cardio Theater, Inc., LCS-1

FCC ID: M4D0318

February 10, 1999

This report concerns (check one): Original Grant ☒ Class II Change ☐

Equipment Type: Intentional Radiator

Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)? yes ☐ no ☒

If yes, defer until: N/A
date

Cardio Theater agrees to notify the Commission by: N/A
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37: yes ☐ no ☒

If no, assumed Part 15, Subpart B for unintentional radiators - new 47 CFR [10-1-92] provision.

Report prepared by:

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Report No. CARD0013

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1.0 General Information

1.1 Product Description

Manufactured By Cardio Theater, Inc.

Address 21420-D NW Nicholas Court, Hillsboro, OR 97124

Test Requested By: Rick Hoagland

Model LCS-1

FCC ID M4D0318

Serial Number(s) N/A

Date of Test..... February 10, 1999

Job Number..... CARD0013

The Equipment Under Test (EUT) is the Cardio Theater LCS-1. The EUT is a single channel transmitter. The audio stereo signal comes to an electronic volume control and then to a stereo modulator. The composite stereo signal is then used for direct FM modulating the VCO at 905-925 MHz.

Hardware Description:

- Clocks/Oscillators Frequencies: 38kHz, 4 MHz, 905-925 MHz
- Ports: Stereo Audio Input, 12Vdc Supply Input
- Antenna: Permanently Attached, Monopole, 1.5 dBi gain, Japan Electronics, Model JA-900-RS

1.2 Related Submittals/Grants

None.

1.3 Tested System Details

EUT and Peripherals

| Item | FCC ID | Description and Serial No. |
|----------------|---------------|--|
| EUT | M4D0318 | Cardio Theater, LCS-1, Low Power Transmitter, Serial No. None. |
| Radio Receiver | | Radio Shack, 12-201A, Serial No. None. |
| Power Supply | | CUI, DPD120050-P5, Serial No. None. |

Cables:

| Item | Description |
|----------------|---|
| Signal (Input) | 3.7 meters in length. Not shielded and no ferrite beads. Metal connector. Connected from the EUT to the Radio Receiver. |
| Power | 1.9 meters in length. Not shielded and no ferrite beads. Plastic connector. Connected from the EUT to the Power Supply. |

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters. Please reference Appendix I for further detail on Test Methodology.

1.5 Test Facility

The Open Area Test Site and conducted measurement facility used to collect the radiated and conducted data is located at

Northwest EMC, Inc.
30475 NE Trails End Lane
Newberg, OR 97132
(503) 537-0728
Fax: 537-0735

The Open Area Test Site, and conducted measurement facility used to collect this data is located at the address shown above. This site has been fully described in a report filed and accepted by the FCC. (31040/SIT)(1300B3). It is also recognized under the National Voluntary Laboratory Accreditation Program (NVLAP Lab Code: 200059-0) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations.

Northwest EMC, Inc., has been assessed and accredited by NEMKO (Norwegian testing and certification body) for European emissions and immunity testing. As a result of NEMKO's laboratory assessment, they will accept test results from Northwest EMC, Inc., for product certification (Authorization No. ELA 119).

Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Lab Code: 200059-0.

2.0 System Test Configuration

2.1 Justification

The EUT was configured to simulate typical use. Cables were attached to each of the available I/O Ports. Radio attached to Stereo Input. The mode of operation utilized for testing was selected in order to best simulate typical EUT use. The measurements were made with the EUT transmitting at Low, Mid and High frequencies (Groups 2, 6 and 7 respectively) in an authorized band.

2.2 EUT Exercise Software

Since there is no external data connection available, no external software can be used.

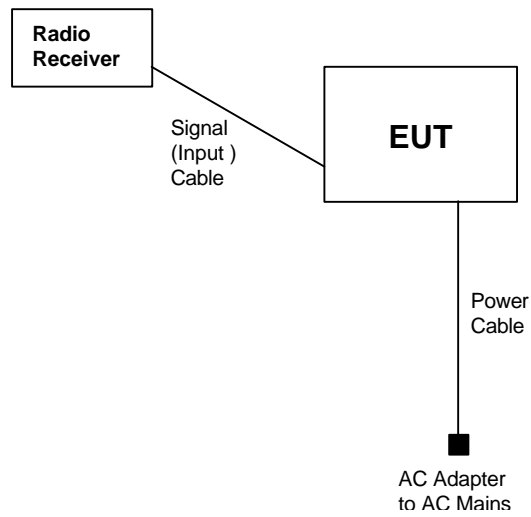
2.3 Special Accessories

No special accessories are sold with the EUT.

2.4 Equipment Modifications

No EMI suppression devices were added or modified. The EUT was tested as delivered.

Figure 2.1: Configuration of Tested System



3.0 Conducted Emissions Data

3.1 The initial step in collecting conducted data is a spectrum analyzer, peak scan of the entire measurement range. All signals with less than 3 dB margin are then measured using a quasi-peak detector. Complete graphs and data sheets may be referenced on the following page. Minimum margins are listed below:

FCC Part 15 Class B Specification Limits (Peak data)

Group 2

| Frequency (MHz) | Measured Level (dBuV) | Limit (dBuV) | Margin (dB)* | Lead |
|-----------------|-----------------------|--------------|--------------|------|
| 15.475 | 41.2 | 48.0 | 6.8 | High |
| 15.495 | 39.8 | 48.0 | 8.2 | High |
| 0.452 | 38.7 | 48.0 | 9.3 | High |
| 0.476 | 35.6 | 48.0 | 12.4 | High |
| 0.505 | 33.9 | 48.0 | 14.1 | High |
| Frequency (MHz) | Measured Level (dBuV) | Limit (dBuV) | Margin (dB)* | Lead |
| 15.495 | 42.1 | 48.0 | 5.9 | Low |
| 15.475 | 38.7 | 48.0 | 9.3 | Low |
| 0.972 | 32.5 | 48.0 | 15.5 | Low |
| 0.970 | 31.8 | 48.0 | 16.2 | Low |
| 0.976 | 31.2 | 48.0 | 16.8 | Low |

Judgment: Passed, minimum margin of 5.9 dB.

Group 6

| Frequency (MHz) | Measured Level (dBuV) | Limit (dBuV) | Margin (dB)* | Lead |
|-----------------|-----------------------|--------------|--------------|------|
| 15.495 | 38.5 | 48.0 | 9.5 | High |
| 15.475 | 38.0 | 48.0 | 10.0 | High |
| 0.464 | 36.0 | 48.0 | 12.0 | High |
| 0.484 | 35.9 | 48.0 | 12.1 | High |
| 0.505 | 34.8 | 48.0 | 13.2 | High |
| Frequency (MHz) | Measured Level (dBuV) | Limit (dBuV) | Margin (dB)* | Lead |
| 15.495 | 42.6 | 48.0 | 5.4 | Low |
| 15.475 | 38.6 | 48.0 | 9.4 | Low |
| 0.970 | 30.9 | 48.0 | 17.1 | Low |
| 0.968 | 29.5 | 48.0 | 18.5 | Low |

Judgment: Passed, minimum margin of 5.4 dB.

3.1 Conducted Emissions Data (continued)

Group 7

| Frequency (MHz) | Measured Level (dBuV) | Limit (dBuV) | Margin (dB)* | Lead |
|-----------------|-----------------------|--------------|--------------|------|
| 15.475 | 42.5 | 48.0 | 5.5 | High |
| 15.495 | 40.8 | 48.0 | 7.2 | High |
| 0.478 | 37.9 | 48.0 | 10.1 | High |
| 0.456 | 37.1 | 48.0 | 10.9 | High |
| 0.975 | 34.5 | 48.0 | 13.5 | High |

| Frequency (MHz) | Measured Level (dBuV) | Limit (dBuV) | Margin (dB)* | Lead |
|-----------------|-----------------------|--------------|--------------|------|
| 15.505 | 44.8 | 48.0 | 3.2 | Low |
| 15.475 | 39.6 | 48.0 | 8.4 | Low |
| 1.082 | 33.8 | 48.0 | 14.2 | Low |
| 0.970 | 33.6 | 48.0 | 14.4 | Low |
| 0.860 | 31.9 | 48.0 | 16.1 | Low |

Judgment: Passed, minimum margin of 3.2 dB.

All readings listed above are Peak, using an IF Bandwidth of 9 kHz, a video filter was not used.

Test Personnel:

Tester Signature: _____

Date: 02/10/99

Typed/Printed Name: Dan Haas

4.0 Radiated Emissions Data

4.1 The following data lists the six most significant emission frequencies, total (corrected) levels, and specification margins. Correction factors, antenna height, table azimuth, etc., are contained in the data sheets immediately following. Explanation of the correction factors is given in paragraph 7.2 of this report. Complete graphs and data sheets may be referenced on the following pages. Minimum margins are listed below:

FCC Class B Specification Limits

Transmit – Group 2

| Frequency (MHz) | Detection | Total Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)* | Polarization |
|--------------------|-----------|-------------------------|-------------------|--------------|--------------|
| 911.203 | AV | 87.7 | 94.0 | 6.3 | Horizontal |
| 911.204 | AV | 90.2 | 94.0 | 3.8 | Vertical |

Judgment: Passed, minimum margin of 3.8 dB.

Transmit – Group 6

| Frequency (MHz) | Detection | Total Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)* | Polarization |
|--------------------|-----------|-------------------------|-------------------|--------------|--------------|
| 913.000 | AV | 87.6 | 94.0 | 6.4 | Horizontal |
| 913.000 | AV | 90.2 | 94.0 | 3.8 | Vertical |

Judgment: Passed, minimum margin of 3.8 dB.

Transmit – Group 7

| Frequency (MHz) | Detection | Total Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)* | Polarization |
|--------------------|-----------|-------------------------|-------------------|--------------|--------------|
| 923.629 | AV | 87.2 | 94.0 | 6.8 | Horizontal |
| 923.629 | AV | 90.4 | 94.0 | 3.6 | Vertical |

Judgment: Passed, minimum margin of 3.6 dB.

4.1 Radiated Emissions Data (continued)

Harmonics – Group 2

| Frequency (MHz) | Detection | Total Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)* | Polarization |
|-----------------|-----------|----------------------|----------------|--------------|--------------|
| 1819.238 | AV | 46.7 | 54.0 | 7.3 | Horizontal |
| 1819.238 | AV | 53.3 | 54.0 | 0.7 | Vertical |
| 2732.627 | AV | 42.9 | 54.0 | 11.1 | Horizontal |
| 2732.627 | AV | 47.4 | 54.0 | 6.6 | Vertical |
| 3645.895 | AV | 49.7 | 54.0 | 4.3 | Horizontal |
| 3645.895 | AV | 51.1 | 54.0 | 2.9 | Vertical |
| 4556.550 | AV | 49.6 | 54.0 | 4.4 | Horizontal |
| 4556.550 | AV | 50.5 | 54.0 | 3.5 | Vertical |

Judgment: Passed, minimum margin of 0.7 dB.

Harmonics – Group 6

| Frequency (MHz) | Detection | Total Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)* | Polarization |
|-----------------|-----------|----------------------|----------------|--------------|--------------|
| 1824.406 | AV | 40.7 | 54.0 | 13.3 | Horizontal |
| 1824.406 | AV | 52.9 | 54.0 | 1.1 | Vertical |
| 2738.288 | AV | 46.0 | 54.0 | 8.0 | Horizontal |
| 2738.288 | AV | 45.6 | 54.0 | 8.4 | Vertical |
| 3652.788 | AV | 49.1 | 54.0 | 4.9 | Horizontal |
| 3652.788 | AV | 51.5 | 54.0 | 2.5 | Vertical |
| 4565.110 | AV | 50.2 | 54.0 | 3.8 | Horizontal |
| 4565.110 | AV | 49.9 | 54.0 | 4.1 | Vertical |

Judgment: Passed, minimum margin of 1.1 dB.

Harmonics – Group 7

| Frequency (MHz) | Detection | Total Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)* | Polarization |
|-----------------|-----------|----------------------|----------------|--------------|--------------|
| 1847.720 | AV | 41.2 | 54.0 | 12.8 | Horizontal |
| 1847.720 | AV | 47.9 | 54.0 | 6.1 | Vertical |
| 2771.590 | AV | 45.5 | 54.0 | 8.5 | Horizontal |
| 2771.590 | AV | 47.6 | 54.0 | 6.4 | Vertical |
| 3695.120 | AV | 48.0 | 54.0 | 6.0 | Horizontal |
| 3695.120 | AV | 50.4 | 54.0 | 3.6 | Vertical |
| 4618.145 | AV | 49.3 | 54.0 | 4.7 | Horizontal |
| 4618.145 | AV | 49.2 | 54.0 | 4.8 | Vertical |

Judgment: Passed, minimum margin of 3.6 dB.

Test Personnel:

Tester Signature: _____

Date: 02/08/99

Typed/Printed Name: Greg Kiemel

4.2 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured level. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

where : FS = Field Strength

 RA = Measured Level

 AF = Antenna Factor

 CF = Cable Attenuation Factor

 AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4 and a Cable Factor of 1.1 is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/meter.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dBuV/meter}$$

$$\text{Level in uV/m} = \text{Common Antilogarithm} [(32 \text{ dBuV/m})/20] = 39.8 \text{ uV/m}$$

4.3 Measurement Bandwidths

Peak Data

| | |
|--------------------------|----------|
| 150 kHz - 30 MHz..... | 10 kHz |
| 30 MHz - 1000 MHz..... | 100 kHz |
| 1000 MHz - 2000 MHz..... | 1000 kHz |

Quasi-peak Data

| | |
|------------------------|---------|
| 150 kHz - 30 MHz..... | 9 kHz |
| 30 MHz - 1000 MHz..... | 120 kHz |

All radiated measurements are quasi-peak unless otherwise stated. A video filter was not used.
All conducted measurements are peak unless otherwise stated. A video filter was not used.

5.0 Measurement Equipment

| Instrument | Model | Serial No. | Freq. Range | Last Cal | Cal Due |
|----------------------|-------------------|------------|--------------------|----------|----------|
| Horn Antenna | EMCO 3115 | 9804-5441 | 1 GHz - 18 GHz | 05/13/97 | 05/13/99 |
| LISN | Solar 9252-50-R24 | 971602 | 10 kHz - 50 MHz | 04/09/98 | 04/09/99 |
| Log Periodic Antenna | EMCO 3146 | 9212-3486 | 200 MHz - 1 GHz | 12/30/98 | 12/30/99 |
| Pre-Amplifier | AR LN1000 | 15224 | 100 kHz - 1300 MHz | 07/20/98 | 07/20/99 |
| Pre-Amplifier | AS ASI8732N | 103 | 1 GHz - 2 GHz | 07/08/98 | 07/08/99 |
| Pre-Amplifier | Miteq | 565125 | .5 GHz – 18 GHz | 06/15/98 | 06/15/99 |
| Quasi-Peak Adapter | HP 85650A | 3303A01805 | 10 kHz - 1000 MHz | 05/29/98 | 05/29/99 |
| Spectrum Analyzer | HP 8568B | 2732A03810 | 100 Hz - 1.5 GHz | 05/29/98 | 05/29/99 |
| Spectrum Analyzer | HP8592B | 3133A01198 | 10 kHz - 22 GHz | 05/22/98 | 05/22/99 |

Appendix I: Measurement Procedures

Each frequency was measured in both the horizontal and vertical antenna polarizations.

The EUT position was maximized for each frequency, for both the horizontal and vertical antenna polarizations, using a remotely controlled turntable.

The antenna height was varied from 1 – 4 meters at each frequency, for both the horizontal and vertical positions to maximize the emission level.

The cable and peripheral positions were manipulated to ensure maximum levels at each frequency for both horizontal and vertical antenna polarizations.

All measurements with less than 3 dB margin, as measured with a broadband antenna (Biconical/Log Periodic), were then measured with a tuned dipole antenna.

30 MHz – 1000 MHz measurements are made at an antenna to EUT distance of 10 meters.

1000 – 2000 MHz measurements are made at an antenna to EUT distance of 3 meters.